

TOTAL MAXIMUM DAILY LOAD (TMDL)

**For
Dissolved Oxygen and Nutrients
In
C-25 Canal West (WBID 3160)
C-25 Cowbone Creek (WBID 3189) and
Taylor Creek (WBID 3163)**

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LIST OF ABBREVIATIONS

AWT	Advanced Waste Treatment
BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan
WWTF	Wastewater Treatment Facility

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information

State: Florida

Major River Basin: St. Lucie River Basin

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name and Type	River Basin	County	Constituent(s)
3160	C-25 Canal West	St.Lucie	St. Lucie, Indian River and Okeechobee	Dissolved Oxygen and Nutrients
3189	C-25 Canal West	St.Lucie	St. Lucie, Indian River and Okeechobee	Dissolved Oxygen and Nutrients
3163	Taylor Creek	St.Lucie	St. Lucie, Indian River and Okeechobee	Dissolved Oxygen and Nutrients

2. TMDL Endpoints (i.e., Targets) for Class III Waters (fresh and marine):

The State of Florida has narrative criteria for nutrients stating that in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Biochemical Oxygen Demand (BOD) was also addressed as it is a pollutant that impacts dissolved oxygen (DO). BOD shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

TMDLs for nutrients, BOD, and low DO in WBID 3288A were addressed by analyzing the effects of BOD, total nitrogen (TN), and total phosphorus (TP) loads on dissolved oxygen concentrations using a Nonpoint Source spreadsheet model and the South Indian River Lagoon Pollution Load Reduction Goals. The target for DO is based on the State of Florida's water quality criteria for D.O., which requires that in no case should the concentration of dissolved oxygen be less than 5 mg/L.

3. Nutrient and BOD Allocation to Meet the Nutrient Targets and DO Criteria for WBIDs 3160, 3163 and 3189:

Parameter	WLA	LA	TMDL
	MS4 and WTFs		
TN	50% reduction	50% reduction	50% reduction
TP	80% reduction	80% reduction	80% reduction
BOD	42% reduction	42% reduction	42% reduction

4. Endangered Species (yes or blank): Yes

5. EPA Lead on TMDL (EPA or blank): EPA

6. TMDL Considers Point Source, Nonpoint Source, or both: Both

7. Major NPDES Discharges to surface waters addressed in TMDLs: St. Lucie County MS4 (FLR04E029), Indian River County MS4 (FLR04E068), and the Larson Dairy Barn #3 (FLA139254).

TOTAL MAXIMUM DAILY LOAD (TMDL) NUTRIENTS AND DISSOLVED OXYGEN IN C25 CANAL AND TAYLOR CREEK WBIDS

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Group 2 basin is shown in Figure 1 and includes the St. Lucie and Loxahatchee River Basins. The St. Lucie and Loxahatchee Basins encompass many square miles. To provide a smaller-scale geographic basis for assessing, reporting, and documenting water quality improvement projects, the FDEP subdivided the Group 2 area into smaller areas called planning units. Planning units help organize information and management strategies around prominent subbasin characteristics and drainage features. To the extent possible, planning units were chosen to reflect subbasins that had previously been defined by the South Florida Water Management District (SFWMD). The St. Lucie and Loxahatchee Basins contain eight planning units: C-25/Basin 1, North St. Lucie, C-24, C-23, South St. Lucie, C-44, Loxahatchee, and Coastal. Water quality assessments were conducted on individual waterbody segments within planning units. Each waterbody segment is assigned a unique waterbody identification (WBID) number. Waterbody segments are the assessment units or polygons that have historically been used by the FDEP to define waterbodies in their biannual inventory and reporting of water quality to EPA under Section 305(b) of the federal Clean Water Act. The same WBIDs are also the assessment units identified in the FDEP's biannual lists of impaired waters submitted to EPA as part of their reporting under Section 303(d) of the Clean Water Act.

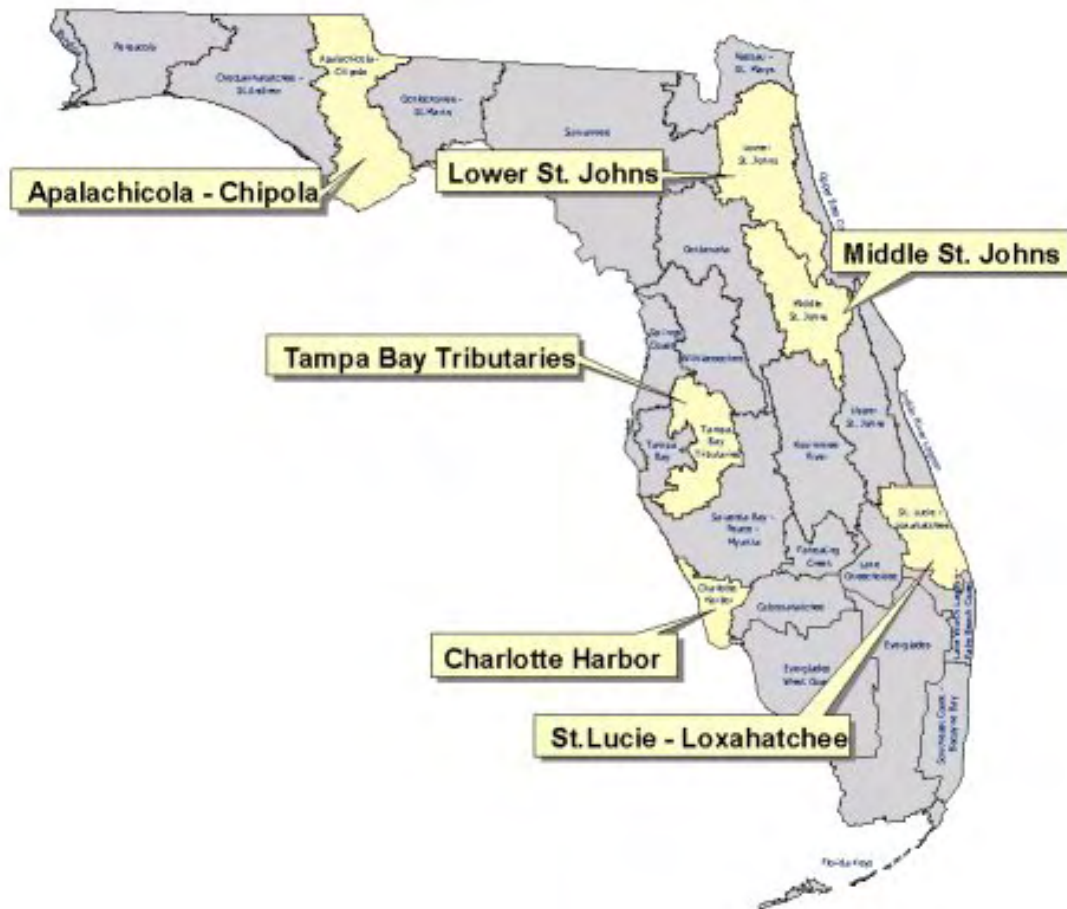


Figure 1: FDEP Group 2 River Basins

Dissolved Oxygen and Nutrient TMDL for C-25 Canal Water Body IDs 3160 and 3189
And Taylor Creek Water Body ID 3163
September 2006

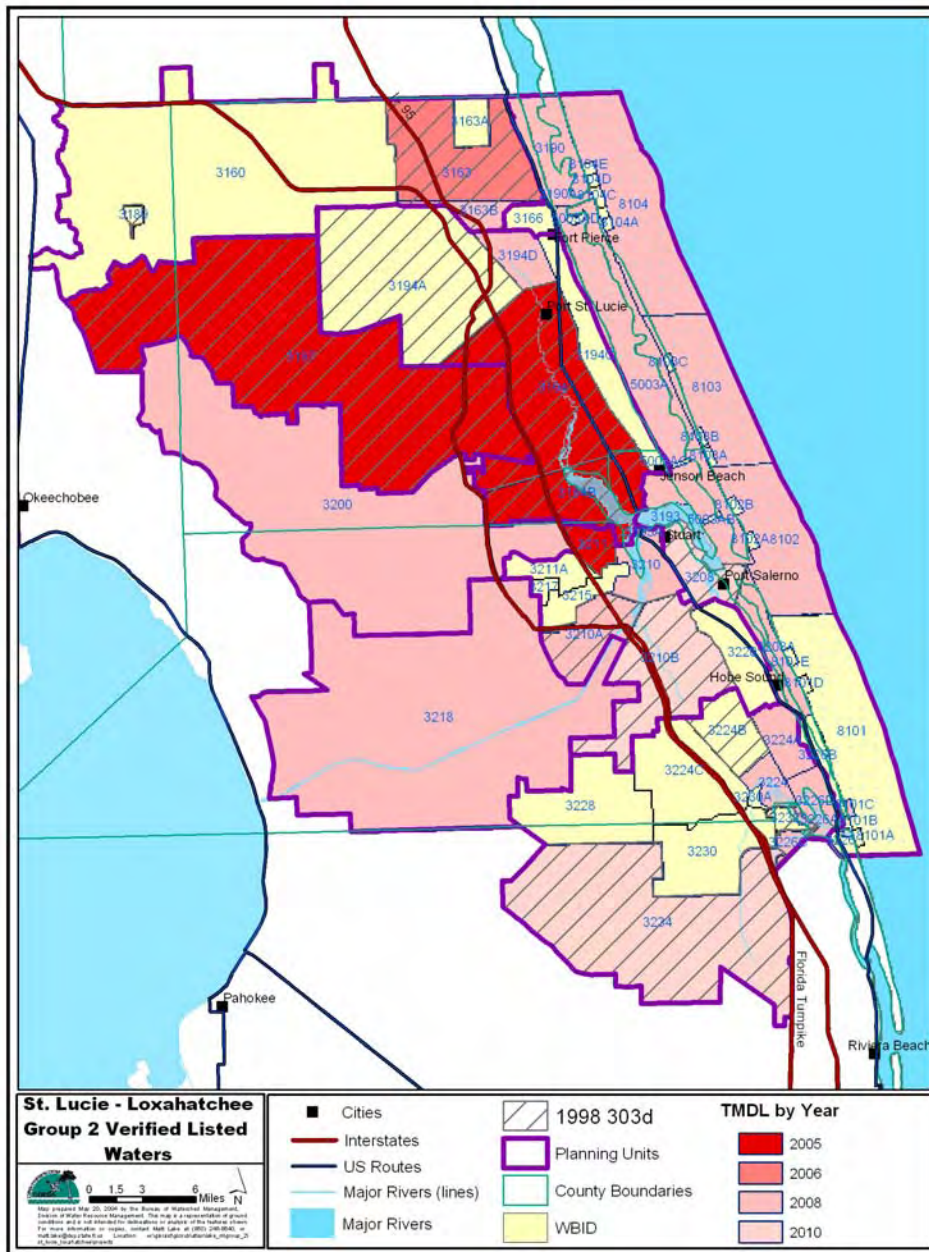


Figure 2: St. Lucie / Loxahatchee River Basin. WBIDs 3160, 3163 and 3189 are on the 1998 303(d) list for Dissolved Oxygen and Nutrients.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified WBIDs 3160, 3189 and 3163 in the St. Lucie River Basin as not supporting water quality standards (WQS) due to Dissolved Oxygen and Nutrients. After assessing all readily available water quality data, EPA is responsible for developing a Dissolved Oxygen and Nutrients TMDL in WBID 3160, C-25 Canal West and WBID 3189, C-25 Cowbone Creek and WBID 3163, Taylor Creek. The location of WBIDs 3160, 3189 and 3163 are shown in Figure 2. The TMDLs addressed in this document are being proposed pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

WBIDs 3160, 3189 and 3163 are designated as a Class III fresh water. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters are further categorized based on fresh or marine waters.

3. WATERSHED DESCRIPTION

3.1. WBID 3160 and 3189

As discussed in the introduction, FDEP manages water resources based on river basins. The river basins are organized from large groups of major river basins to smaller watersheds called planning units, and finally to small waterbody polygons called WBIDs. The St. Lucie River Basin, C-25 Canal Planning Unit, and C-25 Canal West and Cowbone Creek WBIDs are described next. The following information is from the 2003 FDEP Basin Status Report for St. Lucie and Loxahatchee. In the St. Lucie Basin, most of the land in the non-coastal areas is used for the production of citrus and beef cattle. The extensive network of canals that drain these agricultural areas transport storm-water runoff containing nutrients, sediment, bacteria, and other pollutants. These reach the natural drainage-ways (such as the North and South Forks of the St. Lucie River) and ultimately the St. Lucie Estuary and the South Indian River Lagoon. The St. Lucie Canal (C-44), the inland waterway that connects Lake Okeechobee to Florida's east coast, transports regulated releases of water from Lake Okeechobee and runoff from agricultural areas within the C-44 basin. Other major canals also transport storm-water from inland agricultural areas to the estuary. Canals C-23 and C-24 discharge water into the North Fork of the St. Lucie River and the C-25 Canal discharges to the Indian River Lagoon. These canals transport loads of nutrients and eroded sediment to the estuary and slugs of fresh water that create fluctuations in estuarine salinity levels. Urban and residential areas continue to expand in the coastal areas, with polluted urban storm-water runoff and seepage from septic tanks also contributing to the water quality problems in streams and canals. As a result, parts of the St. Lucie Estuary (SLE) appear to be impaired by nutrients, copper, and low levels of DO. Nutrient loads, salinity fluctuations, and accumulations of sediment stress the estuarine ecology. Other evidence of impairment was gathered for the SLE segments in a FDEP South East District biological survey (Graves et al.,

June 2002). Sediment accumulation, decline of sea-grasses and oysters, algal blooms, fish kills, and low diversity of benthic macroinvertebrates in the SLE comprise this body of evidence.

WBIDs 3160 and 3189 are in the C-25 Canal planning unit and WBID 3163 in Taylor Creek of the St. Lucie Basin. These planning unit includes the watershed of the C-25 Canal (also known as Belcher Canal), which transports water eastward across northern St. Lucie County from near the St. Lucie-Okeechobee County border. It includes the C-25, Basin 1, and C-25 East subbasins that are defined by SFWMD. The USGS includes all of these but Basin 1 in the Southeast Florida Coast hydrologic unit. Basin 1 lies in the Indian River South hydrologic unit, as defined by USGS. The planning unit includes a complex network of canals primarily for agricultural drainage that has created a conveyance for discharge to the IRL. Runoff from the western part of the planning unit can discharge southward to the C-24 Canal via the C-25 extension (C-25 EXT). Runoff from the eastern and central portions of this subbasin is conveyed eastward through the S-99 structure on the C-25 Canal. Basin 1, east of S-99, receives drainage from the Ft. Pierce Farms Water Control District (WCD) that was established under Chapter 298, Laws of Florida. The Ft. Pierce Farms WCD Canal #1 is the primary surface water conveyance for Basin 1, providing drainage of the agricultural area and inhibiting saltwater intrusion. Canal #1 and C-25 discharge into the South IRL through the mouth of Taylor Creek at Ft. Pierce. The eastern part of this planning unit includes the northern edge of the Ft. Pierce city limits. Figure 3 is a composite map of this planning unit that shows potentially impaired waters and potential point sources of pollution.

Approximately 10 percent of the C25 planning unit area is defined as wetland and 15 percent listed as pine flatwoods. The largest contiguous wetland area, an extension of the St. Johns Marsh, is located in the northwestern corner of St. Lucie County. One state-managed natural area exists in the C-25/Basin 1 planning unit. The Green Swamp Preserve is located in the northwestern corner. Most waterbodies within this planning unit are agricultural canals used for drainage and/or irrigation that feed the conveyance system provided by C-25 and other SFWMD canals. Although classified as Class III waters, canals are not capable of supporting the diverse ecosystems characteristic of natural streams.

The C-25/Basin 1 planning unit is primarily an agricultural area. Efforts to reduce pollutant loadings to storm-water from individual agricultural land holdings are tied to the active participation of local citrus growers and cattlemen in agricultural best management practices (BMP). These actions are assisted by Department of Agriculture and Consumer Services, University of Florida Institute of Food and Agricultural Science, U.S. Department of Agriculture Natural Resources Conservation Service, and the FDEP. Under the Indian River Lagoon South Feasibility Study, a regional water storage reservoir and a storm-water treatment area (STA) are proposed within this unit. This project will include a 741-acre aboveground reservoir and a 163-acre STA at the S-99 structure on the C-25 Canal. The system will be used to capture local runoff from the C-25 subbasin and the Ft. Pierce Farms WCD. The purpose of this component is to provide peak flow attenuation, a water supply for irrigation, and reductions in concentrations of nutrients, pesticides, and other contaminants. Water quality will be improved in the canal east of the STA and the southern Indian River Lagoon.

WBID 3160 is a large polygon of over 96,000 acres that surrounds the much smaller WBID 3189 that contains only 741 acres. Cowbone Creek is a channelized stream system in the western part of the planning unit that makes up WBID 3189. Cowbone Creek is included on the 1998 303(d) list for coliform, nutrients, and low DO. Land cover in WBIDs 3160 and 3189 is mostly agriculture and wetlands, with about 81 and 52 percent agriculture and 12 and 43 percent wetlands, respectively. The land cover distribution for this and other cover types is shown in Table 1 for WBID 3160 and Table 2 for WBID 3189. WBID 3160 includes most of the C-25 Canal planning unit.

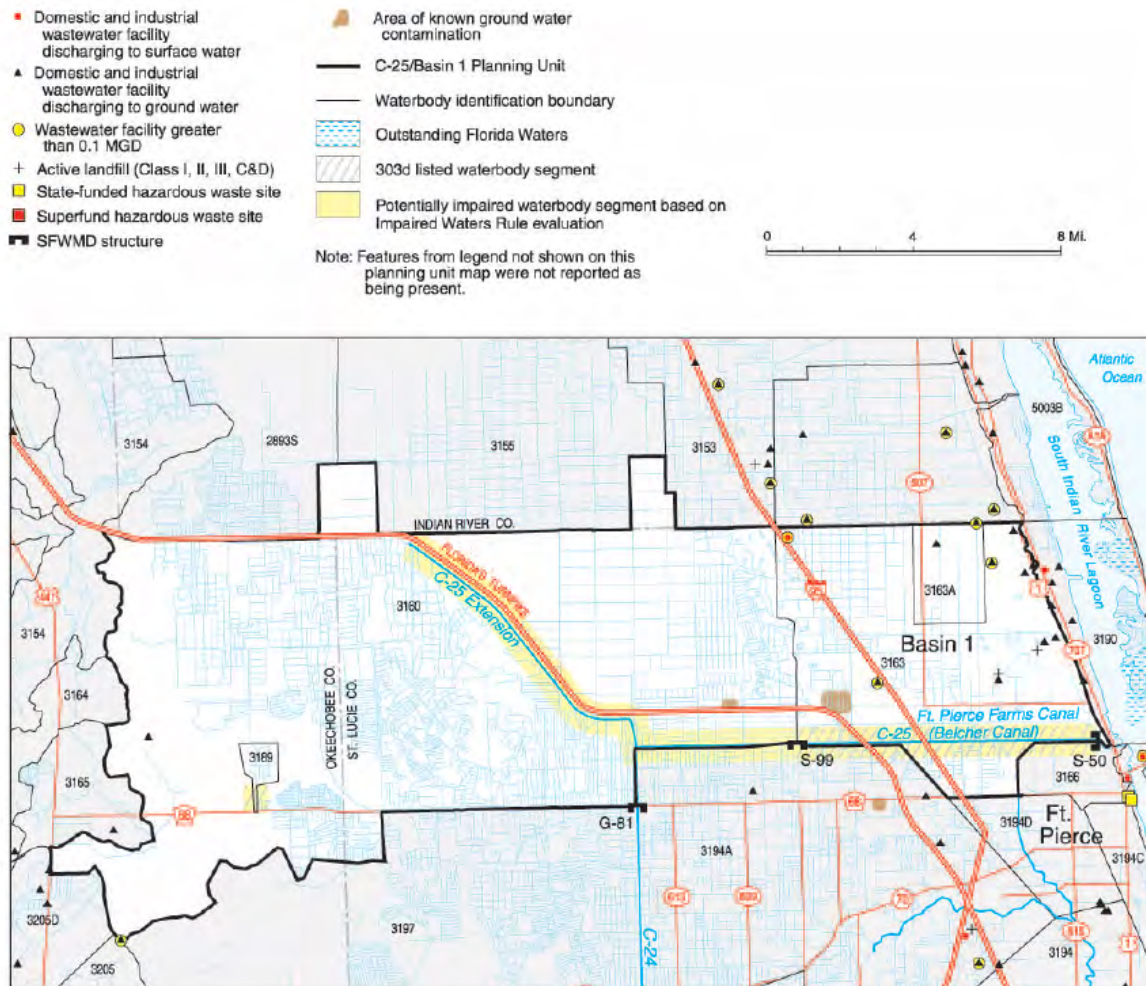


Figure 3: C-25 Planning Unit

Table 1: Land Cover Distribution for WBID 3160 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	260	0%
Commercial, Industrial, Public (1400, 1500, 1800)	42	0%
Agriculture (2000 series)	78448	81%
Rangeland (3000 series)	686	1%
Forest (4000 series)	1074	1%
Water (5000 series)	3022	3%
Wetlands (6000 series)	11278	12%
Barren & Extractive (7000, 1600)	1063	1%
Transportation & Utilities (8000 series)	563	1%
TOTAL (acres)	96436	

Table 2: Land Cover Distribution for WBID 3189 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	0	0%
Commercial, Industrial, Public (1400, 1500, 1800)	0	0%
Agriculture (2000 series)	386	52%
Rangeland (3000 series)	0	0%
Forest (4000 series)	21	3%
Water (5000 series)	12	2%
Wetlands (6000 series)	322	43%
Barren & Extractive (7000, 1600)	0	0%
Transportation & Utilities (8000 series)	0	0%
TOTAL (acres)	741	

3.2. WBID 3163

WBID 3163 (Ft. Pierce Farms Canal #1/Taylor Canal) is located at the northern end of St. Lucie County. WBID 3163 includes many canals in the Ft. Pierce Farms Water Control District Basin 1 (FPFWCD). Over half of FPFWCD Basin 1 is comprised of agriculture, with urban areas taking up about one quarter of the total area. The remaining portion is a combination of upland forest, rangeland, open water and wetlands (FDEP, 2000). The land cover distribution is shown in Table 3 for WBID 3163. A system of canals distributes irrigation water to nearby agricultural areas, and removes any excess rainwater to prevent flooding. Most of the secondary canals ultimately deliver water to the Fort Pierce Farms (C-1) Canal, which joins the C-25 (Belcher) Canal just downstream of a weir to create Taylor Creek. Taylor Creek then empties the large volumes of water it receives from the C-1 and C-25 canals into Indian River Lagoon. Although these canals are known to carry high pollutant loads, this section of Indian River Lagoon is widely considered to have some of the best water quality remaining in the lagoon system (FDEP, 1998). This is because the mouth of Taylor Creek is located almost directly across from the Ft.

Pierce Inlet, allowing relatively high flushing rates in that area of the lagoon. WBID 3163 may be affected by the Phase II MS4 permits FLR04E029, held by St. Lucie County, and FLR04E065, which is held by the City of Fort Pierce. The only NPDES permit in WBID 3163 is Spanish Lake Fairways R O Concentrate (permit FL0140023). Spanish Lake Fairways is a water supply that discharges to a canal in the far northwestern corner of WBID 3163 that should have minimal impact on water quality.

Table 3: Land Cover Distribution for WBID 3163 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	0	2%
Commercial, Industrial, Public (1400, 1500, 1800)	7442	0%
Agriculture (2000 series)	734	91%
Rangeland (3000 series)	1067	4%
Forest (4000 series)	316	1%
Water (5000 series)	963	0%
Wetlands (6000 series)	751	2%
Barren & Extractive (7000, 1600)	5397	3%
Transportation & Utilities (8000 series)	0	0%
TOTAL (acres)	16671	

4. WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	Potable water supplies
Class II	Shellfish propagation or harvesting
Class III	Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use (there are no state waters currently in this class)

Waterbodies are classified as Class III freshwaters, with a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. While the State of Florida does not have numeric criteria for nutrients, a narrative criterion exists as described below. The specific criteria that apply are:

4.1. Nutrients (Freshwater)

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Section 62.302 F.A.C.]. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and fauna [Section 62.302.530 F.A.C.]

Because the State of Florida does not have numeric criteria for nutrients, chlorophyll and D.O. levels are used to indicate whether nutrients are present in excessive amounts.

4.2. Dissolved Oxygen

Freshwater: Dissolved Oxygen (D.O.) shall not be less than 5.0 (milligrams/liter). Normal daily and seasonal fluctuations above these levels shall be maintained.

4.3. Biochemical Oxygen Demand (Freshwater)

Biochemical Oxygen Demand (B.O.D.) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

4.4. Natural Conditions

In addition to the standards for nutrients, D.O. and B.O.D. described above, Florida's standards include provisions that address waterbodies which do not meet the standards due to "natural background" conditions.

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data." [Section 62-302.200(15) FAC].

Florida standards also state at 62-302.300(15) FAC that "Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions."

4.5. Pollution Load Reduction Goals (PLRGs) for the South Indian River Lagoon

The South Florida Water Management District has developed provisional Pollution Load Reduction Goals (PLRGs) for the South Indian River Lagoon. They reported preliminary water quality targets (as concentrations) for various parameters, including D.O. and TN and TP. These targets were derived by using wet season water quality data associated with the five healthiest seagrass transects.

The only parameters that were found to have a significant correlation with seagrass health in the SIRL were color, turbidity, salinity, and pH. They interpreted the lack of significant correlation

between chlorophyll-*a* and seagrass edge as not supporting the eutrophication scenario (excess nutrients cause algal blooms that block light and affect seagrass health). However, they still advocate the preliminary targets, arguing that if the targets are met, then nutrients should not become a problem.

Nutrient impacts may occur in the canals themselves, even if these loads do not appear to be causing a major problem in the lagoon segment at this time. It is important to recognize both the near-field effects in the canals, which are known to have poor water quality, and the lagoon segment (often referred to as IR-22). This segment is the second best in terms of seagrass health in SIRL, and it almost received a “good” rating. Although the SWIM plan notes an improvement in the seagrass acreage, the overall distribution has been relatively stable.

The Indian River Lagoon SWIM Plan established water quality targets for TP (median of 0.053 mg/l) and TN, (median of 0.7 mg/l) based on water quality concentrations in healthy seagrass beds. The concept is to maintain the median values and not exceed the 25th or 75th percentile values on an average annual basis. Efforts to meet these water quality targets and to manage freshwater flows through the St. Lucie River Estuary for environmental enhancement should help stabilize or increase the seagrass edge of bed depth and, therefore, improve the overall health of the South IRL. Estuaries are the receiving water body for a variety of watershed inputs. Therefore, estuarine restoration and management strategies must be linked to watershed management of surface water, groundwater, and atmospheric inputs in addition to the internal processes occurring in the receiving water body. (see <http://www.sfwmd.gov/org/wrp/>). The new Water Supply and Environmental (WSE) regulation schedule for Lake Okeechobee discharges should provide more flexibility for discretionary releases of water for environmental benefits. In addition, pulse releases are prescribed to lower lake stage with minimal impact to the South IRL. Many of the projects that were designed to assess the current status of seagrasses and water quality have been completed. Efforts to monitor changes and trends in over time are continuing (see Chapter 2 Indian River Lagoon SWIM Plan – 2002 Update).

5. WATER QUALITY ASSESSMENT

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). The IWR defines FDEP’s threshold for identifying water quality limited WBIDs to be included on the state’s 303 (d) list. In addition, all waters on the 1998 303 (d) list that were not delisted remain on the current 303 (d) list and require TMDLs. The WBIDs 3160, 3189 and 3163 are on FDEP’s planning list for Dissolved Oxygen and Nutrients. EPA assessed these WBIDs and concluded that they are impaired, and Dissolved Oxygen and Nutrients TMDLs must be developed.

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBIDs are used in the analysis and are shown in Appendix A.

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of nutrients in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of BOD and nutrients.

Non-point sources of BOD and nutrients are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of nutrients on land surfaces and wash off as a result of storm events. Typical non-point sources of BOD and nutrients include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

A geographic information system (GIS) tool, was used to display, analyze, and compile available information to characterize potential sources in the impaired WBID. This information includes land use, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

6.1. Point Sources

In the planning units 3160, 3163 and 3189, FDEP records indicate that there are 12 permitted wastewater treatment facilities, only one of which discharges directly to surface water. The facility having the largest design flow is the Spanish Lake Fairways Reverse Osmosis Plant, which is permitted for a design capacity of 0.78 million gallons per day (mgd) and has an industrial wastewater permit to discharge to surface water. This is a water supply facility that is not expected to discharge BOD and nutrients, and the discharge is outside of WBIDs 3160 and 3189. The other NPDES permitted facility is the Larson Dairy Barn #3 (FLA139254), which is a confined animal feeding operation (CAFO) that discharges to a spray irrigation land application site in the Gomez Creek watershed within WBID 3160. Gomez Creek is a tributary to Cowbone

Creek. The second largest treatment facility is for Spanish Lakes Fairways domestic wastewater discharge, which has design capacity of 0.25 mgd, but does not discharge directly to surface water. Other potential point sources include landfills. There is one Class I solid waste landfill in the planning unit, which is currently not in operation. There are no state-funded or federal (National Priorities List [NPL]) hazardous waste cleanup sites within this planning unit, although there are 2 delineated areas of ground water contamination for the agricultural chemical ethylene dibromide (EDB). Also, according to FDEP records, there have been more than 50 reported discharges from petroleum storage facilities in the planning unit. Figure 3 shows permitted wastewater treatment facilities, landfills, and delineated ground water contamination areas in the planning unit.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge BOD and nutrients to water-bodies in response to storm events. Large, medium, and small MS4s serving populations greater than 50,000 people, or with an overall population density of 1,000 people per square mile, are required to obtain a NPDES storm water permit. There are three MS4 permits in St. Lucie County, five in Indian River County, and none in Okeechobee County. Only the St. Lucie County MS4 (FLR04E029) and the Indian River County MS4 (FLR04E068) are near WBID 3160 and are likely to discharge in the WBID.

6.2. Non-point Sources

Based on Level I and Level II land use summary information (SFWMD, 1995), the predominant land use in the C-25/ Basin 1 planning unit is agriculture (approximately 65 percent of area). The agricultural lands are used for cultivation of citrus (approximately 34 percent of planning unit area) and improved pasture (approximately 28 percent of area). Only 5 percent of the planning unit area is designated as urban/built-up. These land uses can be associated with nonpoint discharges of pollutants and eroded sediments.

6.3. Wildlife

Wildlife deposit nutrients in their feces onto land surfaces where it can be transported during storm events to nearby streams. BOD and nutrients load from wildlife is assumed background, since the contribution from this source is small relative to the load from urban and agricultural areas. Water fowl (e.g., egrets, ducks, wood storks, herons) often frequent storm-water ponds.

6.4. Agricultural Animals

Agricultural animals are the source of BOD and nutrients loadings to streams, that impact water quality. This source includes agriculture runoff from pastureland and cattle in streams. The land use within the impaired WBIDs is 81 and 52 percent agricultural (Table 1 and Table 2), so this land use likely discharges a significant amount of the BOD and nutrient load.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA, 2002). The “Census of Agriculture Act of 1997” (Title 7, United States Code, Section 2204g) directs the Secretary of

Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. In 2002, NASS reported 221,537 acres of farmland in St. Lucie County, 191,333 acres in Indian River County, and 392,495 acres in Okeechobee County. Cattle and calves are the predominate livestock. Confined Animal Feeding Operations (CAFOs) are not known to operate in either St. Lucie or Indian River County. However, dairy farm CAFOs, such as the Larson Dairy discussed previously under point sources, are present in Okeechobee County. Concentrated Animal Feeding Operations (CAFOs) are point sources, as defined by the CWA [Section 502(14)]. To be considered a CAFO, a facility must first be defined as an Animal Feeding Operation (AFO). Animal Feeding Operations (AFOs) are agricultural operations where animals are kept and raised in confined situations. AFOs generally congregate animals, feed, manure, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures. Animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and non-agricultural application of manure to crop land. AFOs that meet the regulatory definition of a concentrated animal feeding operation (CAFO) have the potential of being regulated under the NPDES permitting program.

6.5. Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. The State of Florida Department of Health (www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm) publishes septic tanks data on a county basis. Table 4 summarizes the cumulative number of septic systems installed since the 1970 census. The data does not reflect septic tanks removed from service.

Table 4. County Estimates of Septic Tank Installations (FDEP, 2004)

County	Number Septic Tanks (1970- 2002)
St. Lucie	43,022
Indian River	34,174
Okeechobee	11,432

6.6. Urban Development

BOD and nutrient loading from urban areas is attributable to multiple sources including storm-water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of non-point source pollution by requiring new development and redevelopment to treat storm-water before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. Florida's stormwater program is unique in having a performance standard for older storm-water systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older storm-water management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5) (c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's storm-water programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased storm-water peak discharge rate, volume, and pollutant loadings that accompany urbanization.

7. ANALYTICAL APPROACH

The approach for calculating DO and nutrient TMDLs depends on the number of water quality samples and the availability of data. For nutrient targets the Indian River Lagoon SWIM Plan established water quality targets for TP (median of 0.053 mg/l) and TN, (median of 0.7 mg/l), based on water quality concentrations in healthy seagrass beds, are used. Using an estuary dilution and instream removal rate of 0.7 the TN and TP target concentrations for the watershed are TN of 1.0 mg/l and TP of 0.075 mg/l.

The existing loads are calculated using the Nonpoint Source Spreadsheet Model. The TMDL is expressed as a percent reduction to meet a pollutant concentration target based on natural or targeted conditions. The assumption made is that BOD and nutrients have the major controllable impacts on dissolved oxygen. To return dissolved oxygen to a "naturally" expected condition, not impacted by pollutants, the BOD and nutrient loadings will also need to be returned to natural loading conditions. However dissolved oxygen is also impacted (lowered) by the instream modifications such as dredging and channelization. These processes slow down the water velocity and reduce reaeration and increase solids settling there by increasing sediment oxygen demand (SOD) and may result in a low DO condition. Therefore dissolved oxygen in these WBIDs may not achieve the designated

water quality standards. Further analyses and monitoring will have to be completed to develop an appropriate site specific dissolved oxygen criterion.

Using the land use distribution the existing Total Nitrogen (TN), Total Phosphorus (TP) and Biochemical Oxygen Demand (BOD) loads were calculated based on an average rainfall of 50 inches per year. The 3160 and 3163 TP and TN values were calculated using the Indian River Lagoon targets. The 3160 and 3163 BOD values were calculated by assigning the non-water portion of the drainage area half to forest and half to wetlands in the Nonpoint Source Model and calculating the loads. The existing and natural or targeted loads are listed in Table 5. WBID 3189 is a small watershed contained in WBID 3160 and any reductions assigned to WBID 3160 will also be assigned to WBID 3189.

Table 5 WBID 3288A Estimated Existing and Natural or Targeted TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)*		
	TN	TP	BOD
3160	111,100	22,500	193,750
3160 Natural	56,500	4,285	112,400
3163	890	190	1,520
3163 Natural	445	35	875

* To calculate the total daily load, divide the annual load by 365.

8. DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures. TMDLs for WBIDs 3160, 3163 and 3189 are expressed as a percent reduction.

8.1. Critical Conditions

Critical conditions are accounted for in the analyses by using annual loads and all water quality information and data available for the WBIDs.

8.2. Margin of Safety

TMDLs shall include a margin of safety that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. In this case the measured water quality was used directly to determine the reduction to meet the water quality standard. In this case the lack of knowledge concerns the data, and how well it represents the true water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In the TMDLs for these WBIDs, an implicit MOS was used by targeting a background loading based on natural landuses

8.3. Determination of TMDL, LA and WLA

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards TMDL components for the impaired water-bodies required to achieve the numerical criterion are summarized in Table 6.

Table 6. Summary of TMDL Components for WBIDs 3160, 3163 and 3089

Parameter	WLA	LA	TMDL
	MS4 and WTFs		
TN	50% reduction	50% reduction	50% reduction
TP	80% reduction	80% reduction	80% reduction
BOD	42% reduction	42% reduction	42% reduction

8.4. Waste Load Allocations

The waste load allocation for the Larson Dairy Barn #3 (FLA139254), which is a CAFO that discharges to a spray irrigation land application site in the Gomez Creek watershed, is zero. CAFOs have management plans that describe how the waste will be treated so that no waste water is discharged. Therefore, the concentration of nutrients and BOD for any runoff should be TN of 1.0 mg/l, TP of 0.075 mg/l and BOD of 2.0 mg/l.

8.5. Seasonal Variation

Seasonality was addressed by using all water quality data associated with the impaired WBIDs, which was collected during multiple seasons.

8.6. Recommendations

Determining the source of BOD and nutrients in waterbodies is the initial step to implementing

this TMDL. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

As this TMDL is implemented, the Agency strongly encourages the development of site-specific dissolved oxygen and nutrient criteria for these WBIDs

9. REFERENCES

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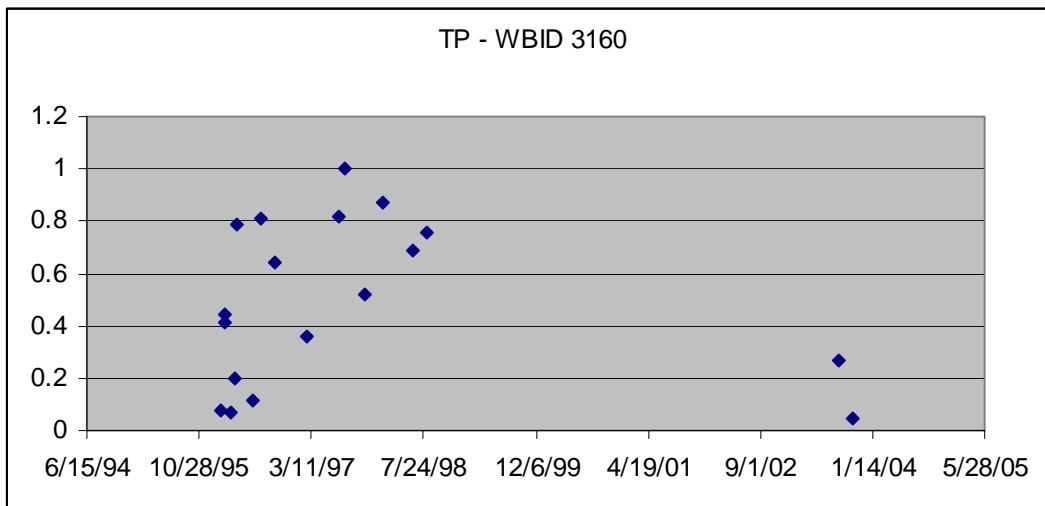
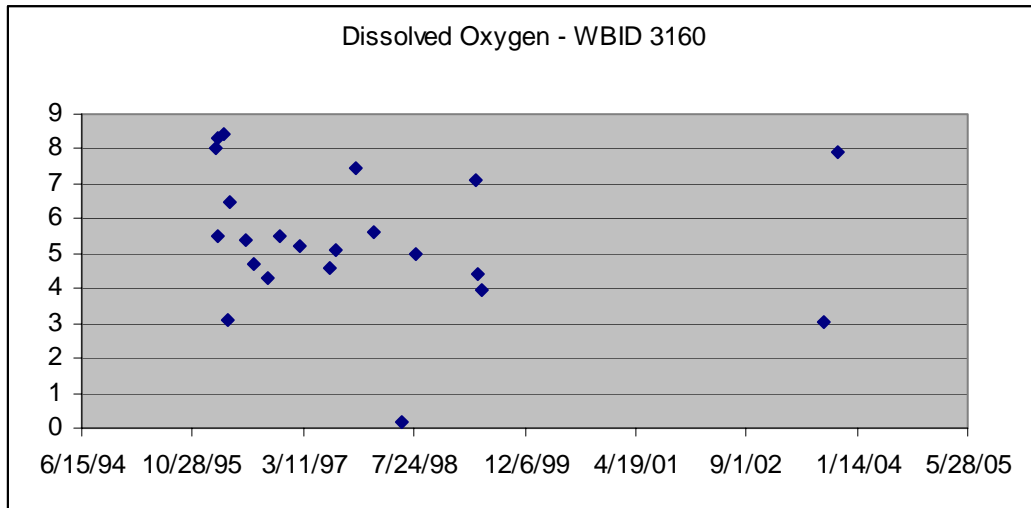
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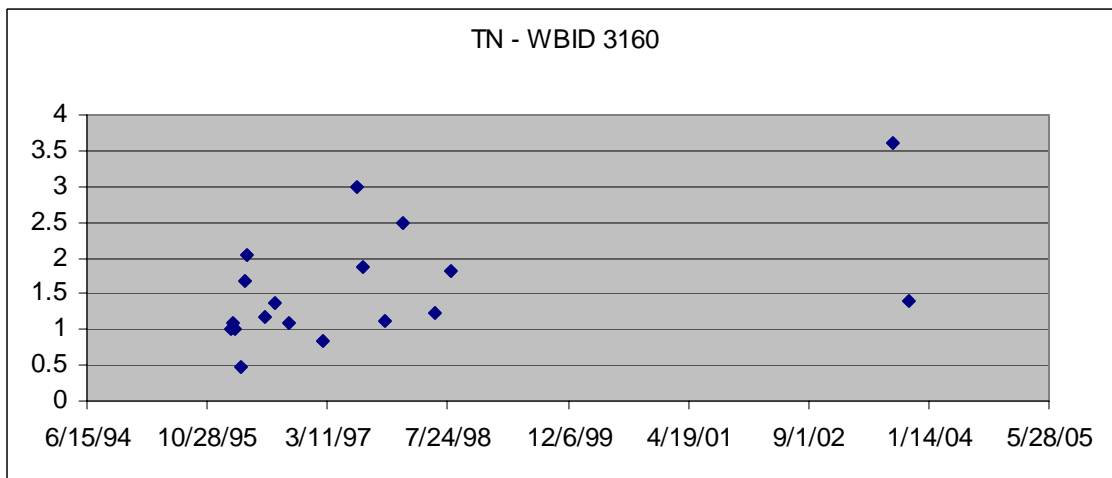
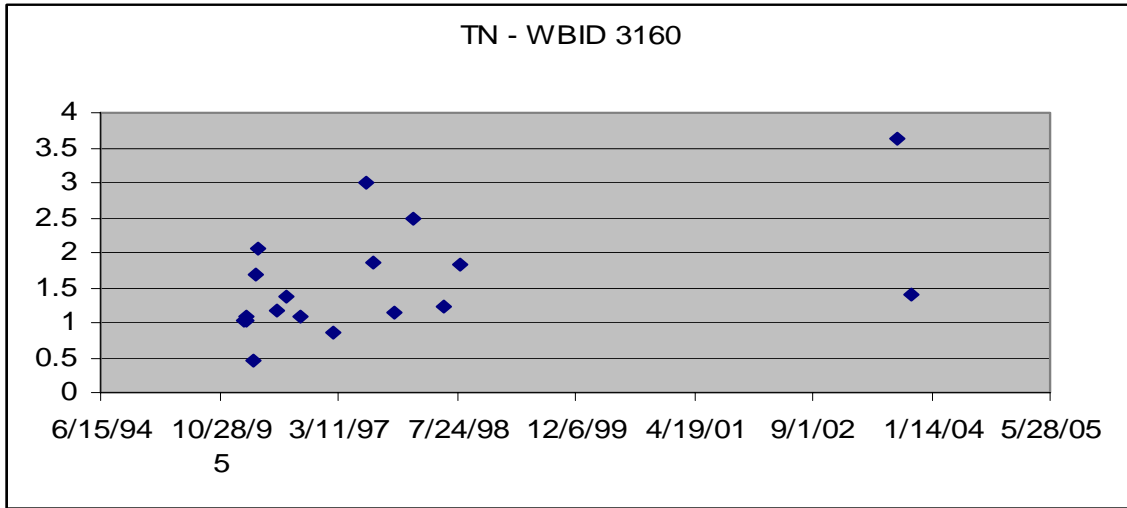
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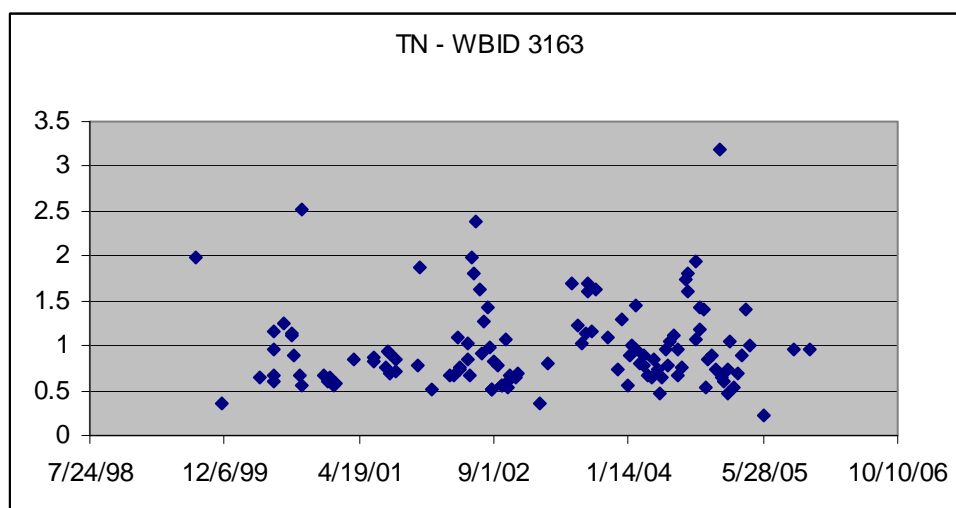
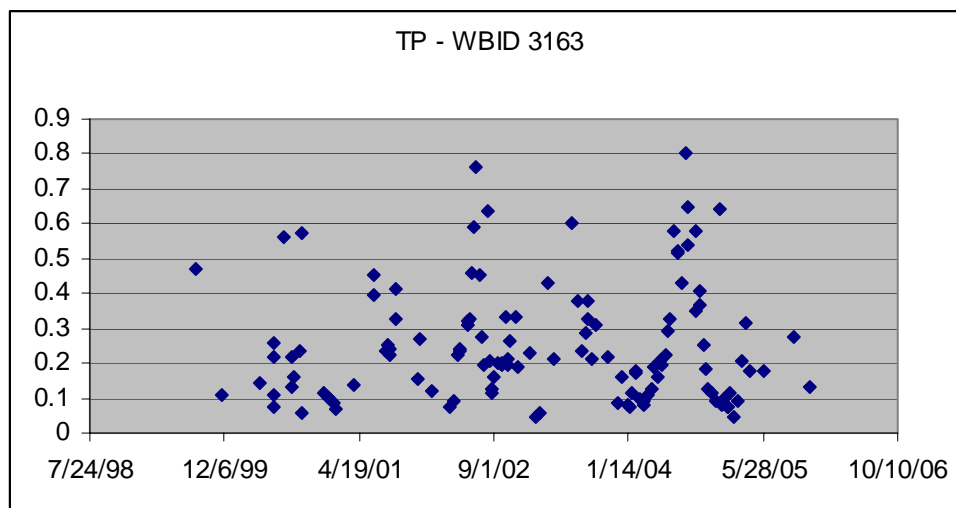
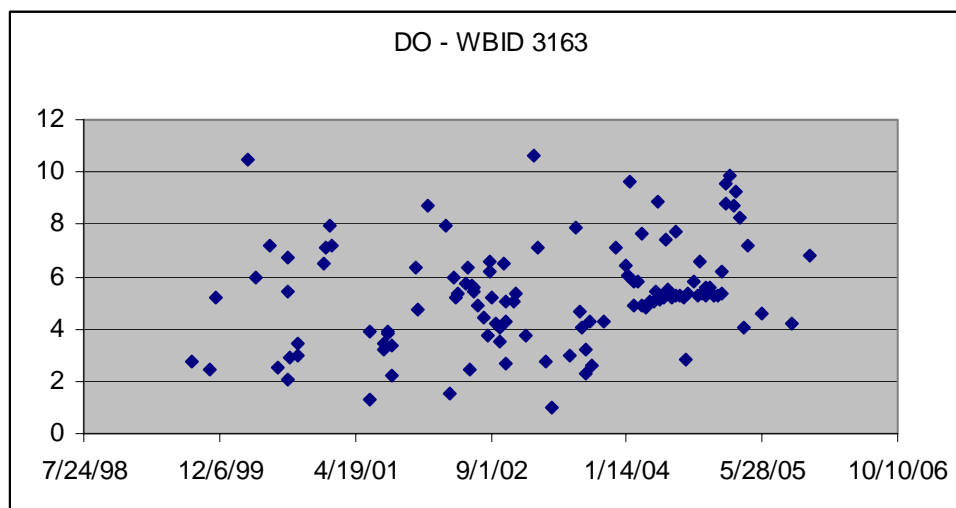
APPENDIX A: WATER QUALITY



Dissolved Oxygen and Nutrient TMDL for C-25 Canal Water Body IDs 3160 and 3189
 And Taylor Creek Water Body ID 3163
 September 2006



Dissolved Oxygen and Nutrient TMDL for C-25 Canal Water Body IDs 3160 and 3189
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